

CALDWELL 377

INVOLUNTARY ACTION

OF THE



NERVOUS SYSTEM.

READ BEFORE THE

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THE INVOLUNTARY ACTION OF THE NERVOUS SYSTEM.

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“The Brain not the Sole organ of the mind, for wherever gray
nerve matter functionates, mind is a resultant.—HAMMOND.

“We can no more stop thinking than we can stop breathing.”
PENDLETON.

“There is nothing great but man; there is nothing great in
man but mind.”—HAMILTON.

“Soul, immortal as its sire, can never die.”

In the words of the great Physiologists, Carpenter, Draper, and Dalton, the great sympathetic distributes its nerve force, to organs, over which consciousness and the will have no immediate control; for instance the functions of the heart, kidney, and liver.

The focusing of the light in the eye; the dilation and contraction of the pupil; the protection of the olfactory membrane relaxing and stretching the tympanum; dilating and contracting the vascular system and the government of nutrition and temperature, etc.

As a typical illustration of involuntary force we will cite its influence on the heart's action—say for seventy years—and, for convenience fix the pulsations at 60 per minute. Then we will have the proposition of $60 \times 60 = 3,600$ beats per hour. Again $3,600$ multiplied by ten equals 36,000 beats in ten hours; or in the words of the learned Draper, this little organ can execute “three thousand million beats without a stop; and propel a half million tons of blood, and momentarily wasting, repairs its own waste all this time.”

The mathematical rhythm of four moving cavities, the perfect closure of its mitral and semi-lunar valves, and the regurgitating play of its tricuspid, have never failed. Much more could be said of other vital organs, all under the control of the involuntary powers. In the face of all these facts, how strikingly true is the saying, “How fearfully and wonderfully we are made,” for, in regard to the heart, we have but to note that its nerve supply springs principally from three little ganglia, and a few nerve fibres originating from the brain, spinal cord and sympathetic.

How delicate the source, how fragile and thread like the conductors; how readily implicated, how sudden and certain the

result. Yet, in death from such a cause, how obscure the character of the lesion.

INVOLUNTARY ACTS OF EVERY DAY LIFE.

For many of the following facts I am indebted to Dr. Pendleton, of Belfast, Maine, taken from a reprint of his annual address, before the State Medical Association, (June 28th, 1870.)

For a plausible explanation of the causes, sources of involuntary actions of man, I am indebted to a paper, by Hammond, entitled, "The Brain not the sole organ of the Mind," published in the Journal of Nervous and Mental Disease," Chicago, 1876.

Man sleeps, dreams, awakes and oft times masticates, works, swears, and prays involuntarily. Says Pendleton, a day seldom passes when we do not find that we have done some slight thing, without knowing it, such involuntary acts as that indicated by the boy's reply, "I didn't whistle, it whistled itself," and so from every stage of life, to the grandmother knitting, asleep in her chair, we have similar illustrations,—the girl at the sewing machine watches her work, but the treadle runs on from habit, not thought, yet her foot stops instantly when she changes her work.

The woman singeth at her spinning wheel;
A pleasant chant, ballad or bacorolle—
She thinketh of her song, upon the whole,
Far more than of her flax; and yet the reel
Is full, and artfully, her fingers feel
With quick adjustment, provident control,
The fibres too subtly twisted to unroll,
Out to a perfect thread—."

In the absent-minded person however, habit works independent of control, and takes advantage of his abstraction, to leads

his feet into the ditch, while his head is among the stars; or lets him swallow the dice, and throw his glass of wine into the back-gammon board.

Huxley tells the story of a French Soldier, who was shot in the left parietal bone, and in consequence became paralyzed on the opposite side of the body. Recovering in two years, from the paralysis, he entered upon a double existence. In his normal life he was perfectly well, and a capital hospital attendant. For a day or two in each month, he passed into another life, without intimation. In this abnormal existence he was active, moved about as usual, and was to all appearances, the same person as in his normal state. He went through all the ordinary habits of his life, yet during what may be termed this artificial, unreal existence, he neither saw, tasted, heard or smelt; nor was he conscious of anything whatever, and there was only one sense in a state of activity, that of touch, which was exceedingly delicate. If an obstacle obstructed his way, he knocked against it, and went to one side. If he was pushed in any direction he went straight on.

Another illustration is that of an old mule that had spent its life grinding bark, and, when too old for service, was turned out to grass. At stated intervals, every day he was observed to leave grazing, and travel round and round an apple tree, in the pasture. We can find individuals or even nations, whose life is hardly less mechanical than that of the poor soldier, or the broken down mule.

INVOLUNTARY THOUGHT.

But we need not limit ourselves to mere physical action. Recent experiments and investigations are rapidly bringing us to the conclusion, that a large number of the acts of the mind, as well as of the body, may be produced under a two-fold form; that there

are two co-ordinate modes of mental activity, the one conscious and the other unconscious. We can no more stop thinking, than cease breathing. Since the time of Leibnitz the leading Metaphysician of Germany, and such as Hamilton and Mill, of England, have affirmed that the mind may undergo modifications of great importance, without being itself conscious of the process.

It is familiar to every one, that when we have been trying to recover a lost idea, and have abandoned the effort, some time after, when busily engaged upon some other subject, it comes to us unbidden. The best solution of a perplexing question is often obtained by an unconscious process, where the attention has been completely withdrawn. Speaking upon this subject, Dr. Holmes relates an anecdote of Lord Polkomente, a Scotch judge, who, being asked how he prepared himself for a judicial decision replied; “Ye see I first read a’ the pleadings; and then, after letting them wamble wi’ the toddy in my wame, two or three days, I gie my ain interlocutor.”

When an author of a late work on “Democracy and Monarchy in France,” was charged with a certain passage verbatim from De Tocqueville, he could only say; “I believe there is such a thing as unconscious memory.” Every one has experienced the advantage of a night’s sleep, in modifying the decisions of a previous day.

A dream has frequently supplied the clue to a labyrinth in which the mind was hopelessly lost during its hours of wakefulness. Carpenter mentions the case of an eminent judge, who, sleeping in a strange house, dreamed that lizards were crawling over him. He could not imagine what had originated such a dream, unt’l in going into the apartment through which he had passed the previous evening, he noticed a mantel clock, on the base of which were figures of crawling lizards. This he must

have unconsciously seen, and the sight must have left a trace on his brain, though it left no record in his memory. Dreaming often takes for its materials, traces left by occurrences long since past.

Galen was accustomed to attach much importance to the medical intelligence of dreams. He declares that a man dreamed that his left thigh was transformed into a marble stone, and within a short while thereafter, he actually lost the use of his member by a dead palsy. A wrestler dreamed that he was in a vessel filled with blood and so deep that the crown of his head was scarcely visible. Galen inferred that the man was in want of a liberal blood letting, and by that means the pleurisy from which he was suffering was cured. Genius has often confessed that its sleeping self, surpassed its waking self.

Now the best explanation for all these strange phenomena of involuntary acts, deeds and thoughts, is to be found in the admirable reasoning of Hammond in the theory that "Brain is not the sole organ of the mind," when he argues that we have no evidence to show that the mind can exist independently of the nervous system. On the contrary, every fact in our possession bearing upon the question of their relation, goes to prove that where there is no nervous system there is no mind; and where there is injury or derangement of the nervous system, there is corresponding injury or derangement of the mind. When we inquire into the matter of the absolute and relative quantity of gray nerve tissue, we find that in this respect, man stands pre-eminent, and it is to this fact that he owes the great mental development which places him so far above all other living beings, for it is the gray tissue which originates mind.

The white nerve tissue, as is well known, serves only for the transmission of impressions and impulse, unless regard is paid to this point, we would certainly fall into a serious error, in

determining the relation existing between the mind and the nervous system, but, having it in view, the connection is at once clear and well defined, there being no exception to the law, that the mental development is in direct proportion to the amount of gray matter entering into the composition of the nervous system, of any animal of whatever kind. But all the gray tissue of the nervous system is not confined to the brain. A large proportion of it is found in the ganglia of the sympathetic, and some other nerves, and an amount second, only to that of the brain in quantity; and indeed, in some animals a large amount is present as an integral constituent of the spinal cord. By the term mind I understand a force developed by nervous action. It bears the same relation to gray nerve tissue, that heat, electricity or light, do to chemical or mechanical action. Why mind should result from the functionation of gray nerve tissue is no more a mystery than the fact that the mixing of water with sulphuric acid develops heat, or the rubbing of a piece of sealing wax with a piece of silk causes the evolution of electricity. All are equally beyond our understanding. All are equally ultimate facts in science and speculations, in regard to the rationale of these all are equally vain and unprofitable.

All the manifestations of which the mind is capable, in its fullest development are embraced in four acts; perception, the intellect, the emotions, and the will. Either one of these may be exercised independently of the others. Thus an individual may have a perception without any intellectual, emotional, or volitional manifestation; and so the intellect, the emotions, or the will, may be brought into action without the necessary participation of each other. It is, however, clearly established that all mental processes, of any kind, have their origin in perception, and that an individual born without the ability to perceive, either from defects in the external organs of

the senses, or of the central ganglia, by which impression on these organs are converted into perceptions, would be devoid of intellect, emotion and will; would be in fact, lower in mental development than the most degraded types of animated beings. But let us suppose a case of a man with a disease of the upper part of the spinal cord, of such a character as to prevent its conveying volitional impulses from the brain to the muscle of the lower limbs. Now, let the soles of the feet be tickled, and we will find that they are drawn away, and generally with much more force than when the brain is allowed to act. Such a movement is probably one of a true reflex character. It is spasmotic and indeterminate, being more extensive than is necessary. But let us go still further in our suppositions, and imagine that in such a case the mere drawing away of the foot was not sufficient to escape the irritation, and that the individual deliberately lifted up the other foot in the attempt to remove the offending object, and that this action, not proving adequate, he made two or three leaps, in order to escape. What will we call these movements? Would they not be evidence of perception and will? Would they not be movements performed with a definite purpose, the very best possible under the circumstances, to escape from the irritation, even though the brain were unconscious of them. It must be remembered that consciousness is not the necessary accompaniment of volition.

Warm-blooded animals are, for many reasons, not suitable subjects for experiments, such as are required in the phenomena under consideration, but in some of the lower animal's, as the frog for instance, we find those conditions present which fit them for such investigation. Thus, if the entire brain be removed from a frog, the animal will continue to perform those functions which are immediately connected with the maintenance of life. The heart beats, the stomach digests, and the glands of the

body continue to elaborate the several secretions proper to them. These actions are immediately due to the sympathetic system, though they soon cease if the spinal cord be materially injured. These movements are calculated to excite astonishment to those who see them for the first time, and who have embraced the idea that all intelligence resides in the brain. For instance, if in such a frog, the web between the toes is pinched, the limb is immediately withdrawn; if the shoulder is scratched with a needle, the hind foot of the same side is passed to remove the instrument; if the animal is held up by one leg it struggles, if placed on its back, a position to which frogs have a great antipathy, it immediately turns over on its belly. If one foot be held firmly with a pair of forceps, the frog endeavors to draw it away. If unsuccessful it places the other foot against the instrument and pushes firmly in the effort to remove it. Still not succeeding it writhes the body from side to side, and makes a forward movement.

All these and even more complicated motions are performed by the decapitated alligator, and in fact may be witnessed to some extent in all animals. I have repeatedly seen, says Hammond, the headless body of the rattlesnake coil itself into a threatening attitude, and when irritated, strike its bleeding trunk against the offending body. Upon one occasion a teamster on the Western plains had decapitated one of these reptiles with his whip and while bending down to examine it more carefully was struck by it full in the face. So powerful was the shock to his nervous system, that he fainted and remained insensible for several minutes. According to Maine de Biran Perrault reports that a viper, whose head had been cut off moved determinately towards its hole. This subject has been well studied by Dr. Towler, of New Orleans, Fluger, Paton, Onimus, and several others.

Now when we come to man and observe the experiments which are constantly being made for us, both in health and in disease, we cannot avoid placing the spinal cord much higher as a nerve centre than it is usually located by physiologists.

In anni-cephalic monsters, we have interesting examples of the facts that the spinal cord is possessed of perception and volitional power. Syme describes one of these beings which had lived six months. Though very feeble, it had the faculty of sucking, and the several functions of the body appeared to be well performed. Its eyes clearly perceived the light, and it cried if the candle was extinguished. After death the cranium was opened, and there was found to be an entire absence of the cerebrum, the place of which was occupied by a quantity of serous matter, contained in the arachnoid. The cerebellum and pons varolia were present.

Panizzat, of Pavia, reports the case of a male infant, which lived eighteen hours. Respiration was established but the child did not cry, nevertheless it was not insensible. Light impressed the eyes, as the pupils acted. A bitter juice put into the mouth was immediately rejected. Loud noises caused movement of the body. On post-mortem examination there was found no vestige of either cerebrum or cerebellum, but the medulla oblongata and pons varolia existed. There were no olfactory nerves; the optic nerves were atrophied, and the third and fourth pairs were wanting. All other cranial nerves were present.

In conclusion, Hammond deduces these propositions:

First. That of the mental faculties, perception and volition are seated in the spinal cord, as well as in the cerebral ganglia.

Second. That the cord is not probably capable of originating mental influence independently of sensorial impressions. The same may be said of the brain.

Third. That as memory is not an attribute of the mental influence evolved by the spinal cord, it requires, unlike the brain, a new impression, in order that mental force may be produced.

Dreams should be considered as involuntary acts of the brain, greatly influenced by the sympathetic, as the condition of the digestion modifies their character. A patient once applied to Dr. Abernethy in consequence of continually dreaming of his grandfather. "What do you eat so late for? What do you eat at bed-time?" asked the doctor; "Not much sir, only half a mince-pie." "Go," says Abernethy, "eat a whole one, and you will dream of your great-grandfather."

If the sympathetic has so much to do with our dreams, we can then better account for the beautiful images produced by opium and other narcotics, stimulants, etc.

First. How belladonna dilates the pupil, how opium contracts it by their direct influence on the sympathetic, and by the sympathetic reflex action on the brain.

In my next paper, we will consider the diseases of the vasa motor and some other important derangements of involuntary action.

“THE UNITY OF FORCE.”

Electricity, its Superlative Velocity.

BY J. J. CALDWELL, M. D., BALTIMORE, MD.

All phenomena of the organic and inorganic world are now being interpreted in terms of matter, motion, and force. The pilot idea of the doctrine of evolution at the present day is, that everything proceeds from the simple to the complex; and that behind all the manifestations of matter and of mind, lies the “Unity of Force.” It is the acting, living, persistent principle which ever sits at the loom of time, arranges the position and the texture of the threads that make up the web.

This ancient weaver, “Force,” has received many appellations. When force coheres among molecules, we call it cohesive attraction. When it asserts itself among the ultimate atoms, constructing them into the delicate and beautiful crystal, we call it the crystallizing force. When engaged in uniting kindred atoms, we call it chemical force or chemical affinity. Our meaning, however, is sufficiently indicated without further extension of the list of forces.

Nature delights in prodigality of result, but she is parsimonious in the number of her working powers. Given a little matter, and motion, and she will construct a world.

The lines of force radiate in all directions, always acting, always persistent. Difference of result is but the product of the same force differently conditioned. A tree and a mammal owe their origin and growth to the same parent force.

In the ultimate analysis we reach simplicity of cause and "unity of force" there is "unity in variety and variety in unity." All that science can do, armed and equipped as she now is, if truthful to her high calling, is to recognize the important fact that, back of all the working energies of nature, there lies the light of a universal intelligence, so guiding controlling and compounding the manifold manifestations of "force," that the final outcrop of all shall redound to the best good of the creature and the everlasting glory of the Creator.

We have indicated the essential unity of "force," and the great diversity of its results. What "force" is *per se*, we know not. We can only watch the play of its untiring activities through the realm of nature.

Mysterious essence, vital "force,"
We fain would all thy secret know;
Would find at last the hidden source
From whence thy powers ever flow

But ours, alas! is finite sphere:
A larger vision, by and by,
May be, will solve what puzzles here.
Till then, on trusting faith rely.

Perhaps one of the most impressive instances of the play of force is to be seen in the phenomena of light. Light is but the result of the rapid oscillations of ether waves. Hundreds of millions of these waves strike the retina per second before we are conscious of the sensation of light. How this sensation is translated into consciousness, is a mode of force of which we know

nothing. One fact, however, has been determined, viz.: that color is a result of motion. Less rapid oscillations are required to produce in us the sensation of the red in the spectrum than of the violet. Electricity, which is the most intense of all light, is but a product of exalted motion; this can be illustrated by suspending a rod in a darkened room, with machinery attached, so as to increase its motion at pleasure. A certain degree of motion produces sound; this motion increased, produces heat; a further increase produces all the colors of the spectrum in their regular order; the utmost rapidity of motion produces electric light. What more beautiful demonstration of the unity, and yet diverse action of motion, which is only another name for "force."

But it were useless to detail a tithe of the protean results of this silent, mysterious agency. Force, being persistent, must always act; it must produce results. Harmony in results implies harmony in the conditions under which force is brought to act. Want of harmony in results implies a want of harmonious conditions. Hence what are called freaks of nature, monstrosities, and all forms of diseased action.

The theory of wave-motion in the ether had its origin in the wave-motion of the water and the atmosphere.

The ear sustains the same relation to sound that the eye does to light. There is a close analogy between the harmony of sound and the harmony of colors. The rhythm of sound has its unvarying conditions in reference to the human ear. Atmospheric vibrations, when they exceed a certain number per second, lose their individuality and become merged into a hum or indistinct sound. The auditory nerve is adapted to take in the whole range of the gamut. Sounds, higher or lower, in either direction, cease to be distinct. It is of no consequence whence we obtain our illustrations of the play of force; we still find it, in ultimate analysis, persistent, and a unit. The harmony of the

universe is everywhere apparent. Order, design, adaptation, and law, are everywhere discernible. Its workings are written in letters of living light throughout the organic and inorganic world. It flashes in the light and glows in all the colors of the spectrum. It proclaims itself in all the harmonies of sound, and in the most complex workings of the brain. Ever-boundless space is its work-shop, and never-ending time is constantly recording its mighty results.

It remains to say a word in reference to the more special manifestations of force. The human system furnishes the most appropriate example. From the persistence of force we can but conclude that between the mind and the body there is the closest relation. Sensation, thought, and our most involved sentiments, imply the destruction or waste of the gray tissues of the brain molecules. This waste is only another name for one mode of the play of force. In one word, man is but a product of force, acting, in the first instance, on a germ, hardly microscopic. And mind, with all its wonderful and complicated powers, is evolved from the simplest beginnings. A Raphæl or a Newton was evolved, in common with the lowest order of animal life, from the same dynamic, controlled and governed by the same law, which has its fitting conditions and relations. Want of harmony in these, as we have already remarked, implies want of harmony in result. A healthy mind, healthy morals, and a healthy religion, are the resultants of the unimpeded action of force.

A knowledge of the brain and of the network of the nervous system should be the aim of every physician who would minister to a body or a "mind diseased." The ability to maintain a proper electrical medium, through the exaltation or depression of nerve power, is requisite to every practitioner who would understand, thoroughly, the nervous system.

Electricity's path to empire will, perhaps, be for a long time clogged with doubts and rejected theories. She is now making rapid strides. She is carrying the science of medicine ever onward beyond the ancient landmarks, enriching it with new truths and crowning it with new laurels.

Precisely how electricity acts as a therapeutic agent no experimenter has satisfactorily explained. Though savans, at home and abroad, have elaborated ingenious, erudite theories, still we will maintain our text, "The Unity of Force."

We will further note that electricity is but another name for the most exalted motion known to the human intellect. We are thus enabled, in some degree, to comprehend its action upon the human system, and its appropriate place in medicine, and its action through the brain and its infinite ramifications.

Nerve Velocity is.....	60 yards per second.
Sound " ".....	332 " "
Cannon Ball Velocity is.....	550 " "
Light Velocity is.....	300,000,000 " "
Electricity " ".....	450,000,000 " "

From the preceding table it can be readily appreciated how electricity's direct action may accelerate our natural forces, how its reverse action may depress them, or how its direct or chemical action may dissipate morbid growths or change cell structure; how, through its instrumentality, we may dilate the vascular system, or accelerate the vaso-motor nerve action; or how, through the sympathetic ganglia, exalt the trophic powers, or produce inhibitory action, which effect, as remarked by Althaus and other investigators, is caused if the galvanic current continues to traverse the spinal cord, whatever may be the point stimulated by the electrodes. As long as this current is continued, the spinal cord remains insensible to any excitation. "On breaking the

circuit, mechanical or eletrical excitation of the cord will again give rise to tetanic convulsions of the limbs." The pneumogastric nerve, acting as an inhibitory power to regulate the heart's action, when severed upon the cardiac side, causes the heart to suddenly attain a velocity of 100 to 200 per minute.

Should the positive pole of a constant current be placed upon the proximate, and the negative upon the distal extremity of the severed nerve, with a gentle, direct current in force, the inhibitory power will again manifest itself, and govern the heart's action in a normal manner. If the same experiment be tried upon the sympathetic of either side, at the cervical juncture, we have somewhat similar phenomena in regard to the nutrition of the parts; for, following the incision of the sympathetic, we have a rapid engorgement of the ear, and side of the face and neck, the parts assuming a crimson hue, from vaso-paralysis. Now, should the galvanic current be applied to the proximate and distal end, the circulation will be restored and the parts will assume their normal condition. (See experiments by Brown-Sequard, Cyon brothers, Hitzig, and others.)

Nerve velocity being but 70 to 90 feet per second, may be wonderfully increased by the influence of the direct current of electricity, especially Faradism. For, under the influence of opium, alcohol, cold, or other paralyzing agents, its velocity may be reduced until life is nearly extinct. In this lowest condition of vitality the scientific application of Faradism may restore nerve force, and re-vitalize the patient. (See my paper on "Electricity as a Restorative Agent in Narcosis and Asphyxia," in the *Virginia Medical Monthly*, Nov. 1874, published by permission of the Committee of the American Medical Association, 1874.)

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Brachys